

Claims

We claim:

- 1 1. A digital receiver for detecting symbols in a baseband signal in a DS-
2 CDMA network, comprising:
3 a plurality of spaced apart antennas;
4 a time-frequency rake receiver connected to each of the antennas;
5 an interference canceller connected to each output of each of the rake
6 receiver, each interference canceller producing a contributing symbol in
7 parallel; and
8 a diversity combiner to determine a decision symbol from the
9 plurality of contributing symbols, the decision symbol corresponding to the
10 baseband signal.
- 1 2. The receiver of claim 1 wherein the antennas are spaced about three to
2 five times the wavelength of the baseband signals.
- 1 3. The receiver of claim 1 wherein each rake receiver includes a plurality of
2 rake fingers, and wherein the baseband signal received at each antenna is
3 modulated to a plurality of different frequencies, one frequency for each of
4 the plurality of rake fingers.
- 1 4. The receiver of claim 1 wherein each rake finger has a different time
2 delay.

1 5. The receiver of claim 4 wherein a symbol time is T_b , and wherein the
2 output of each rake finger is sampled at symbol times T_b to form a down-
3 sampled signal for each interference canceller.

1 6. The receiver of claim 5 wherein each interference canceller further
2 comprises:
3 an adaptive filter to receive a real part ($Re(*)$) of the down-sample
4 signal $u_{i,j}$, the adaptive filter including a plurality of taps, each tap having a
5 tap weight, and wherein the tap weights are update every symbol time T_b
6 according to a least mean square process.

1 7. The receiver of claim 6 wherein a sign of an output of the adaptive filter is
2 a reference signal subtracted by the adaptive filter.

1 8. The receiver of claim 7 wherein the reference signal is a training signal
2 during an initial training stage.

1 9. The receiver of claim 8 wherein the training signal is a predetermined
2 random sequence generated by using a polynomial known to the receiver.

1 10. The receiver of claim 1 wherein the outputs of each interference
2 canceller include an error signal and one contributing symbol.

1 11. The receiver of claim 1 wherein the diversity combiner combines all
2 contributing $C_{i,j}$ with different weights according to the error signals $E_{i,j}$, and
3 the decision symbol d 109 is defined by

4
$$d = \text{sgn}\left\{\sum_{i=1}^M \sum_{j=1}^N \alpha_{i,j} C_{i,j}\right\},$$

5 where α_i is a weighting factor

6
$$\alpha_{i,j} = \frac{\sum_{i=1}^M \sum_{j=1}^N E_{i,j}}{E_{i,j}},$$

7 where M is the number of antennas, and $(N-1)$ is the number of frequency
8 shifts at each antenna.

1 12. The receiver of claim 6 wherein a transmitter periodically transmits the
2 training signal to establish initial tap weights for adaptive filter of each
3 interference canceller.

1 13. The receiver of claim 10 wherein a frequency offset is estimated by
2 identifying a location of the decision symbols with the smallest error signal.
3

4 14. The receiver in claim 10 wherein the decision signal has a smallest error
5 signal.

1 15. The receiver in claim 10 wherein the decision signal has a highest signal-
2 to-noise ratio.

1 16. A method for detecting symbols in a baseband signal in a DS-CDMA
2 network, comprising:

